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High resolution model simulations of the currents and water mass transport on the Northwest European Shelf

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We use a high resolution hydrodynamic model to investigate the circulation patterns and fluxes on the North West European shelf over an annual cycle. This implementation of the Proudman Oceanographic Laboratory Coastal Ocean Modelling System (POLCOMS) covers the shelf out to approximately the 200 m isobath, at a resolution of ˜1.8 km. Hence it has the resolution to accurately represent the density driven circulation and a coverage large enough to include all the frontal systems on the shelf and the large scale wind driven circulation. A number of model experiments are used to distinguish between the various forcing mechanisms of the sub-tidal currents: wind, density and oceanic boundary conditions. In the case of the density driven circulation we further distinguish between currents resulting from local density gradients and from the modification of the wind driven circulation by the vertical density structure.

We find that the model reproduces the circulation patterns seen by a range of observations (including current meters, tracers and drifters). All forcing mechanisms tend to generate currents that follow the direction of propagation of coastally trapped waves (i.e. with the coast on the right) and this is reflected in the large scale circulation. The results clearly demonstrate persistent currents along all the frontal systems and the density component of the volume flux over the annual cycle is found to be comparable to the wind and oceanic forced transport in many places. The density component is significantly more persistent, is unidirectional, but tends to be on a smaller lateral scale than the wind driven circulation. These results shed new light on the relative importance of the forcing mechanisms on shelf wide and seasonal time scales suggesting that the density driven circulation cannot be neglected even when the large (time/space) scale transport is considered.